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COMMUNICATIONS

THE EFFECT OF ILLUMINATION AND OTHER FACTORS ON THE ACUITY OF VISION

BY

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(1) *The scope of this investigation.*—(*a*) To find test objects and also methods of testing visual acuity which are applicable to a large number of observers simultaneously and which do not cause visual fatigue; (*b*) to ascertain by their means the effect of increasing the illumination on the perception of fine detail by observers with normal sight and also by those with defective vision; (*c*) to ascertain the effect of replacing daylight by artificial light derived from gas-filled lamps giving the same illumination, on the perception of fine detail; (*d*) to ascertain the effect, in the case of gas-filled lamps of replacing continuous light by flickering light giving the same illumination.

(2) *The test objects.*—The capital letters of the alphabet were selected as the principal test objects for two reasons: (*a*) because of the convenience of being able to use 26 designs of recognized shape and name; (*b*) in order to seek confirmation of the results obtained by previous observers, *viz.*: that the letters differ greatly in the ease with which they are recognized.

The capital letters, with one exception, lay inside a rectangle measuring 25 mm. from top to bottom and 20 mm. from side to side. The black lines forming the letters measured 5 mm. across. The exception was "I" which measured 5 mm. by 25 mm. Block letters (Green's tpye), drawn with Indian drawing ink, each on a separate piece of white millboard, were used. Other test objects were also employed :—(*a*) the test type devised by Hay; (*b*) that employed by Snellen; (*c*) the Snellen "E" test; and (*d*) a grating type of test object (Grid test).

(3) *The experimental technique.*—The experimental work was carried out in three ways: (*a*) by ascertaining the number of mistakes made in the recognition of the letters with prolonged observation, the letters subtending at the eye only a small angle (Method I); (*b*) by ascertaining the number of mistakes made with brief observation of letters subtending at the eye a considerable angle (Method II); (*c*) similar to (*a*) with the letters replaced by the Grid test object (Method III).

Method I.—The apparatus consisted of the letters, the light sources and two mirrors, one plane and the other convex. The rays of light on their way from the letters to the observer were reflected first by the plane mirror and then by the convex one. The latter presented a greatly diminished image of the letters to the observer. Thus within the length of a table of 1.8 metres it was possible to imitate the visual angle produced by a distance of 40 metres.

The letters were presented one at a time in an irregular order and the answers of the observers were recorded. In all the experiments the observer's eyes were shielded from the direct rays of the light source and were in adaptation with the intensity of light under investigation. The illumination of the test card was measured with the lumeter during each set of observations.

Method II.—The letters were exposed to the vision of the observer for a brief time interval by means of a tachistoscope. A fixation mark was provided prior to the exposure so that the observer knew where the letter would appear. The duration of the exposure for each individual part of the letter was 0.019 seconds.

Method III.—This was similar to Method I, but a grid test was employed instead of the letters. The grid test was placed so that its lines first made one angle with the horizontal and then another. The observer had to identify their direction correctly. With each illumination investigated the smallest visual angle was ascertained at which the observer reported correctly in more than 50 per cent. of the trials.

(4) *The measurement of the illumination.*—The illumination on the test letters was measured by means of a lumeter which had been calibrated by the National Physical Laboratory. Our best

thanks are due to them for this valuable assistance, and also for the loan of a standard Osram lamp with the aid of which we were able to re-standardize our lumeter from time to time.

The brightnesses quoted throughout this paper are those actually measured on the white cardboard surrounding the test object in use. The results are expressed in equivalent foot-candles.

(5) *The visual acuity of the observers.*—The acuity of the observers was determined by means of several different tests and under various conditions in order that we could have ample data on which to form the division between normal-sighted and defective observers. Tables I and II show that in bright daylight normal sighted observers can attain an acuity exceeding 2 (12/6 on Snellen's standard, the black lines forming the test objects subtending an angle at the eye of a half minute of arc). They show further that the value of three is sometimes attained in daylight (Snellen 18/6—angle, one-third minute). By artificial illumination (gas-filled lamps) of roughly the same intensity as the daylight, lower values were obtained.

TABLE I.—VISUAL ACUITY (HAY'S TEST).

Daylight.

(About 100 equivalent foot-candles.)

	Hay.	E.	Snellen.
R.J.L. (A)	2	2	2
„ (B)	2.4	2.4	2.4
H.H.	2.4	3	3
H.B.	2	3	3

Artificial Light.

(About 80 equivalent foot-candles.)

	Hay.	E.	Snellen.
R.J.L. (A)	2	1.5	1.3
„ (B)	2.3	2.4	2.3
H.H.	2	2.4	2

(A) = without correcting glasses.
(B) = with correcting glasses.

TABLE II.—VISUAL ACUITY (HAY'S TEST).

(Normal-sighted observers.)

Artificial Light.

(About 80 equivalent foot-candles.)

	1st set.	2nd set (distance increased).
A.S.	1.4	—
W.F.	1.4	—
C.B.	1.4	1.6
W.H.	1.3	1.8
A.R.	1.7	—
V.S.	1.4	1.7
E.H.	1.4	1.6
E.B.	—	1.8

In Table III are given the visual acuities of the observers with defective vision. It will be seen that these range from 0.2 to 1.2 (6/30 to 6/5 Snellen). We took the line of demarcation at 6/5 instead of 6/6 as we felt that 6/6 is too low a standard for normal sight. An observer with an acuity higher than 1.2 is therefore considered normal. The inclusion of A.W. with observers with defective vision is due to his obtaining 0.5 with one eye and not better than 1.2 with the other.

Table IV gives the values for two normal sighted observers rendered defective by means of spectacles.

TABLE III.—VISUAL ACUITY (HAY'S TEST).

(Defective sighted observers.)

Artificial Light.

(About 80 equivalent foot-candles.)

	R.E.	L.E.
A.G.S. - - - -	0.2	0.6
F.C.B. - - - -	0.8	1.1
P.F. - - - -	0.5	0.6
A.W. - - - -	0.5	1.2

TABLE IV.—VISUAL ACUITY.

(Normal sighted observers made artificially defective.)

Observer.		Brightness in equivalent foot-candles.	Test Type. Hay.	E.	Snellen.
R.J.L. - -	No error	80	2.3	2.4	2.3
	Small error [1]	40	1.1	0.9	1.1
	Large error [2]	40	0.9	0.9	0.9
H.H. - -	No error	80	2.0	2.4	2.0
	Small error [1]	40	1.1	0.9	1.1
	Large error [2]	40	1.1	0.9	0.9

[1] R.E. $\frac{+ 0.5 \text{ D. sph.}}{- 1.0 \text{ D. cyl.} \quad 135°}$ L.E $\frac{+ 0.5 \text{ D. sph.}}{- 1.0 \text{ D. cyl.} \quad 45°}$

[2] R.E. $\frac{+ 1.0 \text{ D. sph.}}{- 2.0 \text{ D. cyl.} \quad 135°}$ L.E. $\frac{+ 1.0 \text{ D. sph.}}{- 2.0 \text{ D. cyl.} \quad 45°}$

(6) The effect of intensity of illumination on the number of mistakes per alphabet in the recognition of the test letters by normal sighted observers is shown in Table V.

TABLE V.—METHOD I.

Brightness in equivalent foot-candles	6	40	70	200	600
H.H. Number of alphabets	2	2	—	—	4
Mistakes per alphabet	21.5	13.5	—	—	7
R.J.L. Number of alphabets	2	2	6	6	4
Mistakes per alphabet	19.5	13.5	7.2	6.8	4

Visual angle, 0.47 minutes. Total number of alphabets, 28.
(R.J.L. wore glasses.)

METHOD II.

(Time of exposure = 0.019 sec.)

Intensity in equivalent foot-candles	4.5	30	80	550
Mistakes per alphabet	2.4	1.3	1.7	1.3

Visual angle = 3.4 minutes. 25 alphabets at each intensity. Total number of observers=9. (Table II.)

METHOD II.

(Time of exposure=0.019 sec.)

Intensity in equivalent foot-candles	4.5	25	80
Mistakes per alphabet	9.4	4.4	2.8

Visual angle=1.7 minutes. 17.5 alphabets at each intensity. Total number of observers=7. (Table II.)

The two different methods give results which show that, as the illumination is increased above 4.5 equivalent foot-candles, there is a decrease in the number of mistakes made per alphabet, not only for the two observers H.H. and R.J.L., but also for the eight observers whose initials are recorded in the visual acuity Table II.

(7) Table VI shows that four observers with defective vision gave similar results.

TABLE VI. METHOD II.

(Time of exposure = 0.019 sec.)

Brightness in equivalent foot-candles	4.5	30	80	550
Mistakes per alphabet	7.3	4.4	3.5	3

15 alphabets at each intensity.
Total number of observers = 4. (Table III.)

That two normal sighted observers given defective vision by the aid of glasses behave in a similar manner is shown in Table VII.

TABLE VII.

The effect of illumination on the visual acuity of two observers with artificially produced defective vision (worse than 6/5 normal vision).

METHOD I.

(Visual angle 0.915 minutes.)

(*a*) R.E. $\frac{+ 0.5 \text{ D. sph.}}{- 1.0 \text{ D. cyl.} \quad 135°}$ L.E. $\frac{+ 0.5 \text{ D. sph.}}{- 1.0 \text{ D. cyl.} \quad 45°}$

Brightness in equivalent foot-candles -	1.2	3.5	9.8	45	1700
H.H. - - - - - - -	22°	16*	14.5*	3°	4°
R.L. - - - - - - -	25°	18.5*	15*	9°	3°

*Two alphabets per observer at each intensity.
°One alphabet per observer at each intensity.

(*b*) R.E. $\frac{+ 1.0 \text{ D. sph.}}{- 2.0 \text{ D. cyl.} \quad 135°}$ L.E. $\frac{+ 1.0 \text{ D. sph.}}{- 2.0 \text{ D. cyl.} \quad 45°}$

Brightness in equivalent foot-candles -	1.2	3.5	9.8	45	1700
H.H. - - - - - - -	25°	19*	14*	10°	16°
R.L. - - - - - - -	24°	21*	23.5*	17°	20°

*Two alphabets per observer at each intensity.
°One alphabet per observer at each intensity.

R.L. wore glasses.

These variations in the number of mistakes made in the recognition of the test letters are due to a change in the visual acuity of the eye with change in intensity.

A similar effect is obtained when the distance between the observer and the test letters is varied, the illumination being kept constant, as the following table shows.

TABLE VIII.

The effect of visual angle on the number of mistakes made by normal sighted observers in recognizing the test letters.

Brightness = 6 equivalent foot-candles.—Method I.

Visual angle in minutes - - -	0.86	0.62	0.47
H.H. Number of alphabets - -	6	6	2
Mistakes per alphabet - -	3.5	14.2	21
R.J.L. Number of alphabets - -	18	6	2
Mistakes per alphabet - -	2.8	12.3	19.5

(R.J.L. wore glasses.)

*Bright daylight.—Method I**

Visual angle in minutes - -	0.46	0.41	0.34	0.28
H.H. Number of alphabets - -	5	5	5	5
Mistakes per alphabet -	3.4	7.2	13.8	16.4
H.B.O. Number of alphabets - -	5	5	5	5
Mistakes per alphabet -	2.6	3.4	6.4	16.8

*Hartridge and Owen. *Brit. Jl. of Ophthal.*, Vol. VI, p. 543.

(8) *The effects of illumination on visual acuity.*—Two questions arise:

(*a*) Is a similar effect to be observed for one of the varieties of test used in physical optics, for instance the grating test, in which alternate black and white bars of equal width have to be resolved by the eye?

(*b*) Is it possible to obtain direct data for the relationship between intensity and resolving power?

The answers to both these questions are given in Table IX, where the relationship between illumination and visual angle is given for a grating test object for two observers.

TABLE IX.

By Method III.—(Grid Test.)

H.H.	Illumination in equivalent foot-candles	.14	.98	2.65	18.5	250	1400	2300
	Visual angle	1.25	.88	.75	.63	.57	.58	.56
R.J.L.	Illumination in equivalent foot-candles	.15	1.04	4.2	6.5	31	100	235
	Visual angle	1.25	.84	.81	.72	.63	.59	.58
	———	710	2360	—	—	—	—	—
	———	.59	.65	—	—	—	—	—

It will be seen that there is good agreement between the values obtained by the two observers except at the highest intensity of all. Up to 100 foot-candles there is a steady rise in resolving power, but thereafter it either rises less rapidly or becomes level or even falls. The agreement between our results and those of König using the Snellen "E" test is very good. (See Fig. 1.)

(9) *The resolving power of the eye.*—The means at our disposal did not permit us to investigate this matter further. We sought instead the answer to two questions:

(*a*) Is the highest resolving power which we have obtained in these experiments greater than that to be expected from the optical properties of the eye media or the histological structure of the retina?

(*b*) Is the initial rise in the curve as the intensity increases due to the decrease in the size of the pupil which in its turn has the effect of diminishing aberrations, and is the subsequent fall due to a still further decrease in the pupil introducing diffraction effects, or to some other cause?

With regard to the first question, the highest visual acuity is found to correspond to a distance on the retina of 0.0049 mm.; that is, the distance from centre to centre of the images of the white strips of the grating. This value corresponds fairly well with those of other observers, namely, 0.0045 for a double star, 0.0046 for a chequer pattern, and 0.0036-46 for the grating. It is well

above the optical limit obtained by Abbe's or Fraunhofer's formulae for the resolving power, namely, 0.0029; and above the average diameter of foveal cones, namely, 0.0032. It is clear that a considerable increase in resolving power above that found by us is quite possible. This possibility we propose to investigate at some future date.

With regard to the second question, we found that, even at the highest illumination which we used, the pupil was still quite large

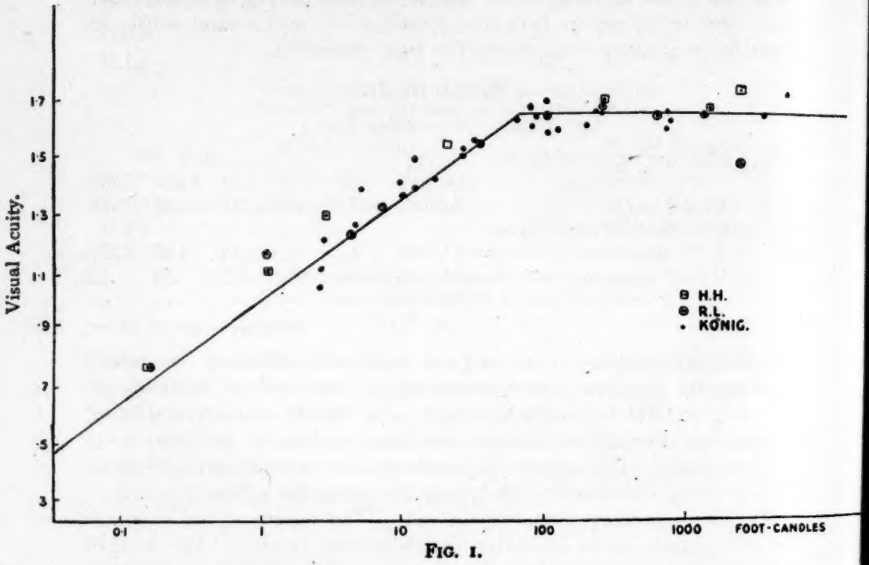

FIG. 1.

in diameter and that it varied but little with change of intensity. The change in resolving power would therefore appear not to be due to the change in diameter of the pupil. The cause must be sought elsewhere.

It is most probably due to an increase in the power of the retina to discriminate detail as the illumination is increased. This has been explained by Hecht as follows: The foveal cones obey the "all or nothing" law, for each one of them either gives its full response or none at all. They are not, however, equally sensitive to light. Thus an increase in the illumination of the retina will increase the number of active cones. If then, as seems very probable, visual acuity depends on the number of active cones per unit area, this should increase as the intensity increases. Also it will follow that at a certain level the last cone per unit area will receive adequate illumination and therefore no increase above this should bring about increased visual acuity. This

deduction of Hecht's fits in with our data and explains the plateau which we found above 100 foot-candles.

(10) *The effects of flickering light on visual acuity.*—The increasing use of alternating current lighting raises the question: Is such a flickering light as good for visual purposes as a non-flickering source? So far as acuity is concerned the results appear to be identical (Table X).

TABLE X.

The effect of substituting flickering for continuous illumination on the visual acuity of two normal sighted observers (H. H. and R. J. L.)

Method I.

Brightness = 6 equivalent foot-candles.

	Flickering. (9 cycles per second.)	Continuous.
Visual Angle.	Mistakes per Alphabet.	
0.86′	3.1	2.8
0.62′	12.5	14.0
0.47′	17.3	16.5

Total number of alphabets = 40.

TABLE XI.

The effect of substituting flickering for continuous illumination on the visual acuity of two observers artificially made defective by glasses.

Method I.

Brightness - - - 3.5 equivalent foot candles.
Visual angle - - - 0.915 minutes.

	Flickering.	Continuous.
0.5 D. cyl. at right angles -	19.0	15.5
1.0 „ „ „ - -	19.5	20.5

Total number of alphabets = 8.

Other comparisons between the results of flickering and non-flickering light have been published.*

The flickering light was produced by interrupting a direct current. A mercury interruptor was used which was driven by an electric motor. The number of interruptions per second could be altered at will. The current was on and off for approximately

*Hartridge, Lythgoe, and Matthews. *Brit. Jl. of Psychol.*, Vol. XVI, p. 293, 1926.

equal periods. In the above tests the rate of flicker was about nine cycles per second.

Summary

(1) An investigation was made on the effect of illumination on visual acuity (*a*) where the test objects subtended only a small angle and were viewed for a prolonged period, and (*b*) where the test objects subtended a considerable angle but were viewed for only a fraction of a second.

(2) By these methods we investigated the effect of intensity of illumination on visual acuity, (*a*) for normal sighted observers, (*b*) for normal sighted observers given defective vision by means of glasses, and (*c*) for observers with abnormal vision. In each case we found a clearly marked increase in visual acuity as the illumination was increased up to about 100 foot-candles. Beyond this intensity no further increase could be found.

(3) The range 1-100 foot-candles covers that ordinarily met with in artificial illumination. An increase in the intensity from 1 to 100 causes only a twofold increase in visual acuity.

(4) Artificial illumination of 2-4 foot-candles is most probably fully adequate for a variety of purposes.

For very fine work on the other hand, where the maximum visual acuity is required, an intensity of 100 foot-candles should be found adequate.

THE BEARING OF STEREOSCOPES ON THE RELATION BETWEEN CONVERGENCE AND ACCOMMODATION

BY

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WHEN we look into any kind of stereoscope, how is the relation between our accommodation and convergence affected? Does the instrument enforce a squint during its use and, if so, of what kind, and how much? And what is the effect of pushing the pictures further away or drawing them nearer? Since stereoscopes are often used for muscle training, a study of this overlooked subject may be useful.

Our natural thought is that to push the pictures away lessens relative convergence and that to draw them up increases it. We shall see that exactly the reverse is the case, and that the effect of pushing the pictures away is to create relative convergence

(artificial esotropia), while the act of drawing them up creates the opposite condition of relative divergence (artificial exotropia). It is all a question of relativity, actual lessening of convergence being accompanied by still greater lessening of accommodation; and actual increase of convergence being accompanied by still greater increase of accommodation.

Before proceeding to prove this it is necessary to consider that no stereoscope can quite reproduce the conditions of Nature, since it cannot make accommodation and convergence increase and diminish strictly *pari passu*. In a stereoscope, while we look at a

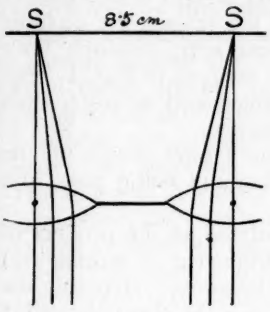


FIG. I.

The stereograms (SS) are in the focal plane, so that parallel light emerges from the lenses, making the distance between the pupils immaterial.

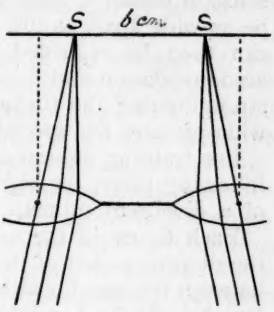


FIG 2.

The stereograms are in the focal plane but, being less far apart than the lenses, induce esotropia.

stationary stereogram, accommodation remains practically unchanged, though convergence is continually varying, from its minimum when we look at the background of the picture to its maximum when we look at the foreground.

When convergence is spoken of in this paper it may be defined as that present when we fuse mid-distance corresponding objects in the two pictures. These, therefore, form the object points for our calculations.

The simplest case to understand is when the pictures lie in the *focal plane* (*i.e.*, in the principal focus) of the lenses. Accommodation is then necessarily nil, for parallel rays enter the eyes. Is convergence also nil? Not necessarily. It is only so when the separation of the pictures is just equal to the separation of the optical centres of the lenses as in Fig. 1. Generally, as in Fig. 2, the separation of the pictures is much less than this, enforcing in consequence a convergent squint. Take, for example, a Holmes stereoscope, in which the optical centres of the lenses are 8.5 cm. apart. Nearly all the stereograms we employ are closer together

than this, a favourite separation being 6 cm., in which case it is evident that, as in Fig. 2, the visual lines must converge considerably, and indeed a simple calculation shows that there is an inward squint of about 13 prism-dioptres (or "tangent centunes" as we might perhaps call them, since Prentice's unit is useful apart from prisms). This is one reason why normal observers feel inclined to draw the pictures up nearer than the focal plane. It is to lessen the uncomfortable squint. The active accommodation induced by this proceeding, however, has the disadvantage of making a distant scene appear less remote. To give the greatest sense of distance, stereograms which depict distant scenes should be as wide apart as the optical centres of the lenses; the pictures can then be regarded in the focal plane with comfort, both accommodation and convergence being at zero, as in Fig. 1. For strengthening the fusion power of sportsmen and aviators, such wide pictures are specially to be recommended.

For training squinters, needs differ, and I have drawn up the following table, the sign of a convergent squint being plus, and of a divergent minus.

Each figure in the middle row is calculated as the product of the dioptric power of the lenses and the difference (in centimetres) between the lens breadths and the picture breadths. Denoting the lens breadth by l and the picture breadth by s the equation reads*

$$n\,\%^{t}\,(n\triangle) = D.\,(l - s).$$

At the focal distance of a Holmes Stereoscope

Breadth of stereogram (in cm.) ...	10	9.5	9	8.5	8	7.5	7	6.5	6
*Artificial squint (tangent centunes)	−8 %	−5¼%	−2½%	—	+2½%	+5%	+8%	+10½%	+13%
Artificial squint in deg. of arc ...	4½°	3°	1½°	—	1½°	3°	4½°	6°	7½°

5.5	5	4.5	4	3.5	3	2.5	2
+15¾%	+18¾%	+21%	+23¼%	+26%	+29%	+31½%	+34%
9°	10½°	12°	13½°	15°	16½°	18½°	19½°

*Unless otherwise specified, % is assumed to be always measured on the tangent.

To give a practical example of the use of the table. A recently operated squint has a residuum, let us say, of +18 per cent. (*i.e.*,

*Since tangent quantities are not suitable for multiplication, a very slightly more accurate formula would be $2 \tan \frac{-1\,D}{2}\,(l-s)$ giving the result in degrees of arc.

18 tangent centunes of convergence) or 10° of arc. We look up the nearest figure to 18 per cent. in the middle row, or to 10° in the bottom row, of the table and find it under 5 cm. A stereogram of this marked breadth should therefore be selected and placed in the focal plane. The patient would then, while wearing his full correction, be in a position for easiest fusion of the pictures. This fusion should be well cultivated by other stereograms, and then each be slowly and steadily drawn up (preferably by means of a long endless screw under the longitudinal strip, operating on the cross carrier) for exercise. When the training has advanced sufficiently by this means, a wider stereogram can be conquered by again starting in the focal plane.

Before leaving the focal plane position of the stereogram, we may notice another interesting feature which it presents, that owing to the parallelism of the emergent beams, as in Figs. 1 and 2, neither the interocular distance, nor that of the eyes from the lenses, has any effect upon either convergence or accommodation. The moment, however, the stereogram is moved away from the focal plane, the case is complicated by variables, for we have now to take account both of the interocular distance which varies with different persons, and of that of the eyes from the lenses, which also differs with different observers and instruments, and even with the same observers at different times. Before showing how to calculate for these measurements, it will, I think, suit the clinical reader best to tackle first an easier problem, which avoids all variables. It consists in determining under what conditions accommodation and convergence are *equal*. I find that the distance of any stereogram from the lenses necessary to make accommodation equal convergence is an easily ascertained multiple of the separation of the pictures from each other. The following general statement is offered as applicable to stereoscopes of all sizes and shapes.

RULE. *Accommodation and convergence agree whenever the ratio between the distance of the stereogram from the lenses and the separation of its pictures is the same as the ratio between the focal length of the lenses and the separation of their optical centres.* If u, s, f, and l denote these four items, $A=C$ when $u/s=f/l$ (or, dioptrically expressed, $sD_l=lD$).

When the lenses of a stereoscope are fixed their focal length *divided* by their separation (or equally their dioptric power, *multiplied* by their separation), is a constant for that instrument, and is the amount by which we have to multiply the separation of the pictures in order to find their neutral distance from the lenses. For example, lenses of 12 cm. focal length, and separated by 6 cm., would require any stereogram to be placed ($12\div6=2$) twice as far from the lenses as the pictures are separated from each other.

The lenses of a Holmes stereoscope have a focal length of about 19 cm. and a separation of 8.5 cm. Therefore, the ratio for that instrument is $19 \div 8.5 = 2.24$. The neutral distance for any stereogram, therefore, will be 2.24 times its own breadth. On this principle I have graduated the longitudinal strip of the Holmes with a series of cross lines, each marked with the breadth of the stereogram of which it indicates the neutral position. Thus, for example, $A = C$ when a 6 cm. stereogram is placed on the line marked 6 cm., or when an 8 cm. stereogram is placed on the line marked 8 cm., and this is true irrespective of what the inter-ocular distance, or that of the eyes from the lenses, may be. Any stereogram when pushed beyond its cross line causes steadily increasing relative convergence, and when drawn up from it causes steadily increasing relative divergence. It will be evident at once that in the treatment of phorias the pictures should play only on the proper side of their cross line and be pushed in the proper direction. An easily remembered rule may be given. *For exo's travel outwards, for eso's inwards.* For a tropia, the same direction of movement holds good, but the starting point has to be different, since it is evident that if the pictures could be fused at the $A = C$ distance, it would not be a case of tropia. We have to make a concession by trespassing on the easy side of the $A = C$ line (beyond it for a convergent squint, and within it for a divergent) until fusion is obtained, and then very gradually work in the training direction. It must be confessed, however, that for pronounced squints, Worth's amblyoscope is more suitable than a stereoscope. For phorias, on the other hand, stereoscopes are more interesting, more varied, and contribute more definitely gradual treatment.

Let us now see how to prove the ratio rule for the neutral distances. We make use for this purpose of the self-evident conception that convergence equals accommodation whenever the visual lines intersect at the point accommodated for. This is physiologically true, in spite of the base-line of accommodation being in advance of the base-line for convergence. If we cling to this simple conception, we have only to arrange the distance at which any stereogram must be placed to make the virtual images of the two mid-points coincide actually (not merely subjectively by fusion) in the median plane. Then each visual line is instinctively directed towards the image proper to it, and for which accommodation also takes place, and since the images coincide, the visual lines intersect at the point accommodated for, quite irrespective of the breadth or distance of the eyes.

In Fig. 3 are seen two similar triangles (ILL and ISS), of which the base (l) of the larger represents the interlenticular, and the base (s) of the smaller, the interstereoscopic separation, the common

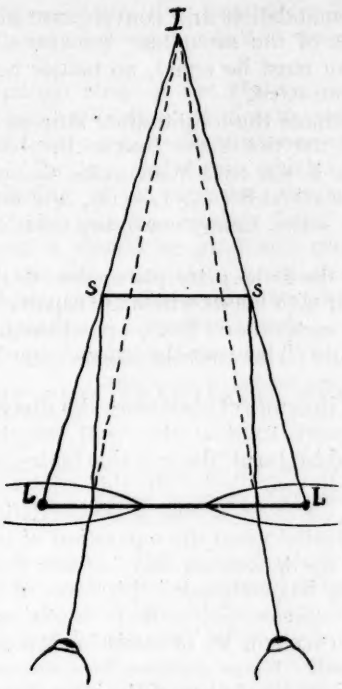


FIG. 3.

When the virtual images (I) coincide in the median plane, the visual lines intersect at the point accommodated for, irrespective of the pupillary separation or the aloofness of the eye.

apex (I) being the site of the two combined virtual images of the object points SS. The distance between the two bases is the *object distance*, which we may call u, while the entire height of the larger triangle is the image distance, which we will call v. *Therefore, the height of the smaller triangle is* $v - u$. Now the triangles being similar, their heights and sides are proportional to their bases and therefore—

$$(v - u)/v = s/l$$

But, by optics, $v = uf\ (f - u)$.

Substituting this value for v, and simplifying,

$$u/s = f/l.$$

or, in words, the required ratio between the distance of the pictures from the lenses (u), and their separation from each other (s), is a constant found by dividing the focal length of the lenses by their separation. This confirms the rule given above. It will be

noticed that accommodation and convergence are both measured by the reciprocals of the same line (measured in terms of the metre) so that they must be equal, no matter how much the line is elongated or contracted.

The way to graduate the longitudinal strip of a Holmes stereoscope is to make the first cross line at the focal length of the lenses and mark it 8.5 cm., then make the other cross lines 11.2 mm. apart, marked 8 cm., 7.5 cm., and so on, towards the lenses, the same series being continued also beyond the focal length.

Let us see how the same principle applies to those stereoscopes which are provided with lenses which are capable of approximation or recession from each other. Here, one of the hitherto invariable factors—the distance (l) between the lenses—now becomes variable, so the ratio l/f is no longer a constant.

In one form of instrument, however, the distance of the stereogram is permanently fixed at the focal length. In that, for example, described by Javal, the movable lenses are of +10D. sph. and the pictures 10 cm. away. In this case $u=f$, and therefore $s=l$ when $A=C$. Put in words, accommodation is nil and the visual lines are parallel when the separation of the pictures equals the separation of the lenses, as may be seen from Fig. 1 of this paper. Dr. Wells has elaborated this form of instrument in his phoro-optometer stereoscope, and I might say that I have recommended his excellent set of cards for my patients since they were first published. There appears, however, to be a little oversight in his directions for the use of the instrument, since he makes the starting point take account of the pupillary distance, which we have shown to be immaterial. The true starting point, at which the visual lines are parallel, is when the separation of the cards (not that of the pupils) equals the separation of the lenses.

In yet another type of instrument, the pictures move as well as the lenses, leaving only one quantity invariable, namely, the power of the lenses; but there again, at any moment, the $A=C$ formula ($u/f=s/l$) still holds good.

Dioptrically $D_1 = Dl/s$.

Conclusions

1. If the pictures of a stereogram placed in the focal plane are closer together than the interval between the optical centres of the lenses, they cause forced esotropia.

2. When drawn nearer, this esotropia gradually lessens and becomes nil at a distance from the lenses equal to the interval between the pictures multiplied by a constant. Nearer still, exotropia enters, increasing with every approach.

3. In every fixed stereoscope, this constant can be found by dividing the focal length of the lenses by their optical separation.

In the Holmes stereoscope, the constant is 2.24, so that the neutral distance for any stereogram is 2.24 times its own breadth from the lenses.

4. The longitudinal strip of the Holmes instrument can be graduated in this manner to save calculation, so that a stereogram of any breadth can be at once placed on its neutral seat if required, beyond which Con. > Acc. and within which Con. < Acc.

5. For the training of an esotrope, the widest stereogram should be selected that can be certainly fused at the *far* end of the instrument, and it should be gradually caused to approach. For an exotrope, the narrowest stereogram should be employed that can be fused as *near* to the eyes as accommodation permits, and it should be gradually caused to recede.

A TREATMENT FOR TRAUMATIC SYMBLEPHARON

BY

E. NICHOLAS HUGHES, M.R.C.S., D.O.M.S.

HON. OPHTHALMIC SURGEON, WALLASEY COTTAGE HOSPITAL
OCULIST TO THE CHESHIRE EDUCATION COMMITTEE

IT too frequently happens, after injuries to the lower lids that a symblepharon forms, and this in spite of all treatment.

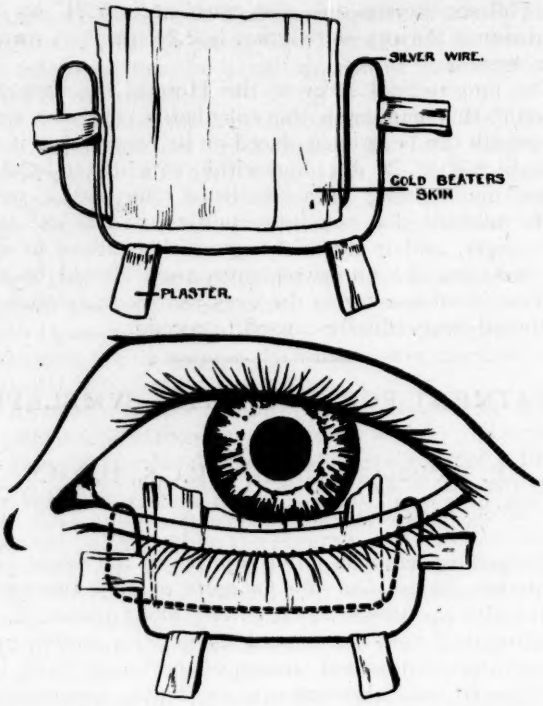
The injuries are those which chiefly affect industrial workers, such as lime and acid burns, and burns with molten metal. In these cases the conjunctival surface of the lower lid is, in places, often destroyed, and also areas on the bulbar conjunctiva.

I have had to deal with about twelve such cases during the past two years. The primary object of treatment has been to prevent union between the palpebral and bulbar conjunctival surfaces. The free application of ointments, small rolls of lint soaked in vaseline and placed in the conjunctival fornix, and the very frequent drawing apart of the opposed surfaces have been employed, but in spite of these measures, union between the lid and globe has occurred.

In order to overcome this union between lid and globe, I employed the following simple apparatus and have used it with remarkably good results:

A sufficient length of silver wire (53 Stubb's system in thickness) is bent as shown in diagram, the free ends of the wire being soldered to make a continuous framework. It will be seen that the completed framework consists of two horizontal bars connected at each end by a loop. One of these bars fits into the conjunctival fornix, whilst the other lies outside the lid, the two loops crossing over the lid edge.

Minor adjustments will be found necessary in individual cases



in order to make the framework comfortable, *e.g.*, a slight curvature with the concavity towards the globe will be necessary for comfortable fitting. The ends of the loops should be a few millimetres from each canthus. A small strip of goldbeaters' skin is placed across the horizontal bar of the framework which lies in the fornix, its free border being trimmed with scissors to keep it clear of the cornea.

The diagram shows the goldbeaters' skin and framework *in situ*. The goldbeaters' skin is sterilized by immersion in 10 per cent. carbolic, then rinsed in sterilized water prior to use. The frame is held in position by strips of adhesive plaster attached to the bar lying outside the lid. The apparatus is removed twice daily for cleansing purposes, a fresh piece of goldbeaters' skin being used on each occasion.

Lotion and antiseptic drops together with a bland oil, *e.g.*, liquid paraffin are instilled at each dressing. Providing the framework fits well the patient can wear the apparatus without discomfort and it should be worn until the bulbar and conjunctival surfaces are healed.

A RETINAL GRATICULE

BY

O. GAYER MORGAN

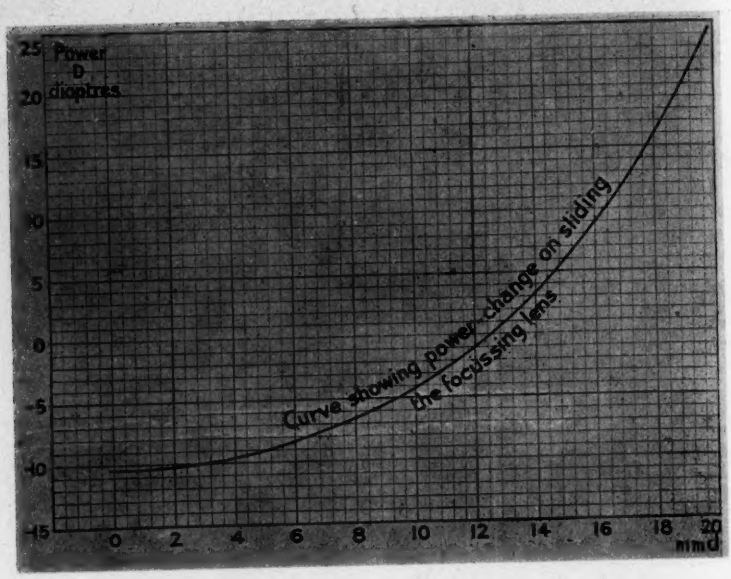
LONDON

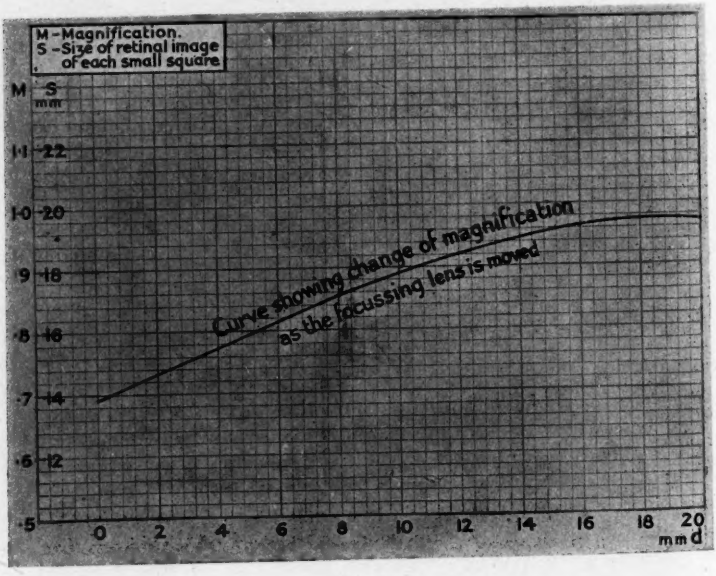
THIS instrument has been devised to overcome two difficulties which have arisen in the past. The graticule consists of finely ruled millimetre squares subdivided into 0.2 millimetre squares. It is used in conjunction with the Keeler ophthalmoscope, and is mounted on a small slide. In order to focus the image of the graticule on the retina, the retinal vessels are first clearly focussed with the ophthalmoscope, and then the focussing lens is moved up or down until the lines of the squares are seen in perfect definition.

The first and most important difficulty occurs in cases of circumscribed elevations in the fundus often at the macula, and in cases of flat pigmented areas, in both of which it is of great importance to be able to say definitely whether a change in size has taken place over a certain period of time. The diagnosis of malignancy often depends entirely on this fact, as clinically a melanoma, a deep haemorrhage, or exudate is often indistinguishable from a flat sarcoma. At present there is no accurate method except that of making a careful fundus drawing, and as a rule taking a rough comparison with the disc or the distance of the edges of the patch from the main vessels. Neither of these methods gives an accurate measurement for future reference.

The second difficulty has occurred in all descriptions of fundus lesions in publications, where no drawing is added. The retinal graticule as will be explained gives an accurate measurement in millimetres of the size of the part under consideration, and consequently this can be visualized more easily; also when making a drawing the parts can be accurately measured and reproduced in correct proportions.

The lines of the graticule are most clearly seen in the macular region, but can in most cases be easily counted in any part of the fundus except on the disc. Presumably because there is no definite plane on which they can be focussed, the lines are very indistinct on the disc margin where the nerve fibres pass over to the retina. This is more noticeable still in papilloedema where the graticule cannot be focussed at all. If necessary a fairly accurate estimate of the transverse measurement of the disc in these cases can be made from the graticule which is clearly in focus above and below. The lines can be clearly seen on the bottom of a physiological or pathological cup, and also on the crescent in


Power
D
dioptres
25
20
15
10
5
0
-5
-10
-15
0 2 4 6 8 10 12 14 16 18 20
mmd
Curve showing power change on sliding the focussing lens


M - Magnification.
S - Size of retinal image of each small square
M
S
mm
1·1 22
1·0 20
·9 18
·8 16
·7 14
·6 12
·5
0 2 4 6 8 10 12 14 16 18 20
mmd
Curve showing change of magnification as the focussing lens is moved

myopic eyes. The transverse measurement of the retinal arteries and veins can be easily estimated and compared.

Magnification.—The magnification produced by the instrument and the size of the retinal image were calculated by the following method. Paraxial rays were traced through the system from an object point at a distance d (variable between 0 and 19.5 mm.). Five values of d were chosen (*viz.*, 0, 5, 10, 15, and 19.5) to enable curves to be drawn. From these figures the dioptric power of the light entering the patient's eye was determined as being the reciprocal of the intersection length of the ray leaving the instrument. Also, the magnification of the image on the retina compared with the original graticule size, was calculated by the theorem of Lagrange, that $M = \frac{N\,U}{N^1 U^1}$, NN^1 being the indices of the air and eye respectively; and $U\,U^1$ being the angle of convergence at the graticule and retina respectively.

From the curves the table below is constructed, giving values of the position of the focussing lens, and the ultimate magnification (M) at a number of different refractive powers.

Powers in Dioptres. D.	Shift of focussing lens. D.=mm.	Size of each square. Approximate Magnification. M.
10	16.4	0.192
8	15.7	0.192
6	15.1	0.192
4	14.3	0.190
3	13.9	0.190
2	13.5	0.188
1	13.0	0.188
0	12.5	0.186
−1	12.0	0.184
−2	11.4	0.182
−3	10.8	0.180
−4	10.2	0.178
−6	8.5	0.172
−8	6.2	0.164
−10	2.8	0.150

The graticule is made of mm. squares, subdivided into 0.2 mm. squares. With an emmetropic eye (D=O), the magnification is 0.93 mm. hence each square covers 0.186 mm. of the actual retina itself. For myopic or hypermetropic eyes, the figures in the table for magnification assume that the error in the refraction is caused solely by elongation or shortening of the eyeball, and not by any error of the crystalline lens; if, however, the latter is the case, then a new table of magnification will be necessary, but the greatest error would not be more than 15-20 per cent. of those given in the table.

PATHOLOGICAL DIFFRACTION HALOS

BY

W. S. DUKE-ELDER

LONDON

RECENT work seems to have established that the coloured halos associated with glaucoma are due to a diffraction phenomenon caused by the corneal oedema occurring in states of raised tension described by Fuchs in 1882. It was held that the optical properties of the interlamellar system of the cornea when altered by stretching would produce such an effect, but Koeppe (1920) has shown that the angular diameter of the rings which such a system would produce was 3° to 3.5°, a value considerably smaller than the measurements of the typical glaucomatous halos (7° to 12°, Elliot, 1923; 10° to 12°, Sheard, 1919; 11° to 16°, Koeppe, 1920). The last-mentioned writer has suggested that they correspond in size with the diffraction necessitated by the fibrillary intersections in the vitreous, but Nordenson (1923) failed to confirm the suggestion experimentally, and the mathematical calculations of Druault (1923), and the optical experiments of Emsley and Fincham (1923) have located the cause of their origin near the anterior surface of the cornea. It would seem that the intraocular fluid is forced into the substance of the cornea in states of raised tension in the same manner as the blood of a hyphaema sometimes insinuates itself here under similar conditions. The fluid appears to collect in the superficial parts of the corneal lamellae beneath Bowman's membrane, tracks along the course of the nerve fibres piercing this membrane, and collects as subepithelial droplets inducing an oedematous state of the corneal epithelium. As light travels through the cornea, on meeting these droplets which differ in their optical properties from the medium in which they lie, it suffers diffraction in the same manner as it is resolved into its component wave-lengths by fluid droplets in the atmosphere in the production of a rainbow, or as occurs when a glass plate is steamed. Alternatively it is possible that the cells themselves, altered by oedema, may be the diffracting bodies.

The validity of this theory would appear to be considerably strengthened if typical glaucomatous halos could be produced in a condition where an oedema of this layer of the cornea occurred without any concomitant rise of tension. This combination is provided in the photophthalmic reaction which follows exposure to ultra-violet light. In the milder degrees of this condition, when the process has not advanced to desquamation of the epithelium, an oedema sometimes occurs; my observations with the slit-lamp

in animals have shown that it may occasionally attain the dimensions of subepithelial vesicles (1926).

Returning late one night from the laboratory suffering from an attack of photophthalmia contracted through carelessness some six hours previously from exposure to a mercury vapour lamp, my misery was to a considerable extent alleviated by observing a distinct halo round every street lamp. These halos were extremely beautiful, and were composed of inner rings of blue and violet and outer rings of yellow and red with a broad band of green in between. Subsequent examination showed that they were of the glaucomatous type, the angular diameter measured from the red ring was 12°, and they reacted to Druault's and Emsley and Fincham's tests. At the same time the tension of the eyes, as measured by Bailliart's scleral tonometer, was 18 mm. Hg, and finger pressure upon the eye had no effect upon the brightness or the size of the coloured rings. The distressing photophthalmic symptoms largely disappeared in eight hours, but the eyes remained congested for two days, and during these forty-eight hours the halos remained, gradually getting fainter and larger. This would appear to correspond with the disappearance of the droplets of oedema, since the optical conditions necessitate that the larger droplets cause small diffraction rings.

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DIRECT OPHTHALMOSCOPY IN HIGH MYOPIA

BY

ALEXANDER GARROW, M.D.

GLASGOW

THE examination of the fundus in myopia of high degree by direct ophthalmoscopy presents considerable difficulty and one has often to be satisfied with the indirect method. This has obvious drawbacks when one wishes to study minute details. Under such circumstances I have found that it is most helpful to make the direct examination with the patient wearing his glasses.

After I had made use of this method with increasing benefit for some time I looked through the chapters on ophthalmoscopy in a

number of textbooks. In only one of these did I find a reference to the method. This is in the following sentences on page 384 of the eighth edition of Fuchs' textbook:

"A still better way of securing a clear image by the direct method particularly when either patient or observer is quite astigmatic or the patient has a high degree (12D. to 20D.) of myopia is for each to wear his correcting glasses, during the examination. Then the fundus is seen with great distinctness with the simple aperture or, if either patient or observer accommodates, with a weak concave lens."

My experience of the method convinces me that it is worthy of more extensive recommendation. The fundus of a high myope wearing the full correction and examined by direct ophthalmoscopy is as clearly seen as that of an emmetrope, and under a similar condition of magnification. Incidentally, too, one knows at once if the patient is wearing the full correction.

The details of the choroidal and other changes associated with high myopia can be accurately examined and the progress definitely appreciated from time to time, and pathological changes of the disc can be very clearly seen, as in a case of glaucomatous cupping with atrophy in a patient whom I see from time to time and who has over 20D. of myopia.

The method is even more useful in detecting lesser changes in the disc. In the ordinary direct ophthalmoscopic examination in the high degrees of myopia the whole field may be occupied by the disc and thus one does not get the same comprehensive view of it and the surrounding fundus as when the examination is made with the patient wearing his glasses. By the latter method, therefore, one gets the benefit of contrast between the disc and the surrounding fundus and it is thus more easy to appreciate departures from the normal colour of the disc.

There are certain difficulties in the method which have been minimized by practice. The greatest is the bright image of the light formed on the patient's glass. If this happens to be in the way, it can be got rid of by tilting his glass, and I find that a slight upward tilt is best. When an electric ophthalmoscope is being used this is easily done by holding the glass between the index finger and thumb of the unoccupied hand and slowly tilting the glass until the light image has been displaced from the pupillary area. When the peripheral portions of the field are being examined it is helpful to tilt the glass slightly towards the part examined.

When the ordinary ophthalmoscope is being used the method is more difficult and it is obviously necessary so to dispose the lamp and the hand which tilts the glass that there is no interference with the light in its passage from its source to the mirror.

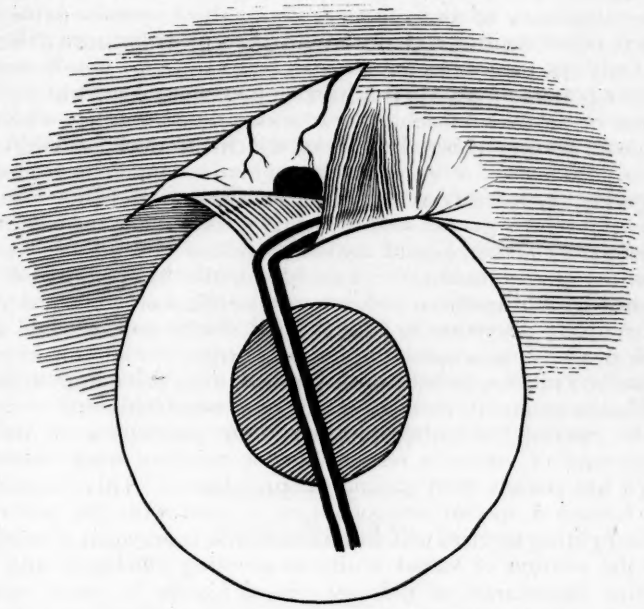
A NOTE ON HOLDING THE CONJUNCTIVAL FLAP IN SCLERO-CORNEAL TREPHINING

BY

A. GERARD EAST

TRURO

THE accompanying illustration shows a method which I have found useful in performing Colonel Elliot's operation for glaucoma. An oblique incision is made through the conjunctiva, and a strabismus hook, or some blunt instrument, inserted; the fold of



conjunctiva can then be held by an assistant. There seems to be less risk of tearing than with forceps or other instruments; and the flap can be controlled easily.

After results seem to be quite satisfactory so far. Filtration proceeds normally, and the oedema covers a fairly large area. I do not usually find it necessary to insert stitches as the flap stays in position and does not appear to block the trephine hole by scarring.

ANNOTATION

The Work of the Medical Research Council

THE report of the Medical Research Council for 1925-1926 gives, in a space necessarily all too restricted, an account of the various researches promoted by it during that period. In the introduction the principles on which the Council acts are clearly enunciated as the following quotation shows: "Financial assistance can have, and has had, inestimable value in promoting research work, but it cannot always command it. Successful work at the growing points of knowledge can only be done by men of the first quality, and their success is only reached through freedom. To use the power of money so as to limit or divert their work to particular objects not of their own choice would be in great measure to waste it. Only the pioneer workers themselves can judge how best and at what point to make their advance upon a problem, whether by frontal or by flank movement. It is they and no others who can lay down as they proceed the lines which the work, viewed as a whole, is to follow. The distributors of money can aid them greatly by giving them freedom and better equipment, and they can aid general progress greatly too, by bringing into fuller activity those investigators of the second rank who follow up and exploit the advances of the leaders." In addition the fixed policy of the Council has always been to leave to scientific workers whom they aid complete discretion to publish their results as and when they think proper in appropriate technical journals. If all Government grants had previously been made on these lines we venture to think that better results in research might have been achieved.

The Special Committee formed in the previous year on the physiology of vision is responsible for excellent work, some of which has already been noticed in our columns. This Committee has formed a special sub-committee to deal with the problems of the fighting services which sub-committee is engaged in examining the relation of visual acuity to shooting efficiency, and the relative importance of different visual factors in naval range-finding. Other subjects at present being worked at are "glare," flicker, the effects of ocular fatigue in industrial occupations involving eye strain, and illumination.

The Council have also under the heading of diseases and anomalies of the eye, continued their support to Professor Karl Pearson and Dr. Julia Bell in their work on the inheritance of diseases and anomalies of the eye, and to Dr. Ida Mann in her work on some abnormal and pathological states of the human eye. Some of the work of the first-named authors was reviewed in our columns (*Brit. Jl. of Ophthal.*, Vol. X, p. 413), while some of Dr. Mann's

work has been published in this journal (*Brit. Jl. of Ophthal.*, Vol. IX, p. 495 and Vol. XI, p. 99) and also in the *Trans. of the Ophthal. Soc., U.K.*, Vol. XLV, p. 696.

From this brief catalogue our readers may gain some idea of the scope of the Council's work in ophthalmology, but this is only a very small part of the work that is being carried on, and those of us who desire to gain some idea of the trend of modern research work are advised to obtain a copy of the report.

In conclusion the Council desire to express their indebtedness to the numerous men of science who have given freely of their time and thought to the work of the various Committees (a list of these follows). They point out, "that it is only right that the public who provide the funds that the Council administer should be aware of the nature of this part of the machinery by which economic and effective distribution of them is in large part assured. If the Council in the administration of their parliamentary grant-in-aid had to pay for expert advice upon any fair remunerative scale the cost of the scientific results attained would be indefinitely increased. The benefits given by the several Committees, morever, have far more than a commercial value. Their work is done through the free association of scientific men for the framing and supervision of the schemes of research with which they are chiefly concerned." physiology of vision is responsible for some excellent work, some of which has already been noticed in our columns. This Committee has formed a special sub-committee to deal with the problems of the fighting services which is engaged in examining the relation of visual acuity to shooting efficiency, and the relative importance of different visual factors in naval range-finding. Other subjects at present being worked at are "glare," flicker, the effects of ocular fatigue in industrial occupations involving eye strain, and illumination.

ABSTRACTS

I.—NEUROLOGY

(1) **Naffziger, Howard C.—A method for the localization of the brain tumours—the pineal shift.** *Surg. Gynec. and Obstetrics.*, April, 1925.

(1) In autopsies on cases of brain tumour, it is a common observation that the portion of brain in which a growth is situated, increases greatly in volume. This is due not only to the presence of the lesion itself but to an increase in the fluid content of the affected hemisphere. In consequence of this there

is often a striking dislocation of the falx and all the mid-line structures. **Naffziger** has noted that the pineal gland is calcified in about 50 per cent. of cases and that it is possible to obtain an outline of the calcified portion on an X-ray plate of the skull. The pineal shadow is usually obscured by the accessory sinuses. When, however, the direction of the ray is parallel to a line drawn between the external canthus and the external auditory meatus, the shadow is projected well above the sinuses. It has been shown that in normal cases the shadow lies exactly in the mid-line. When there is a tumour occupying one hemisphere the pineal gland is pushed over to the opposite side. The degree of pineal shift varies considerably, a common amount is one centimetre but displacements of 2.5-3 centimetres have been found. If the growth occupies the posterior fossa or base, both lateral ventricles are dilated so that the pressure is uniformly distributed and there is no pineal shift. Fifteen cases so far have been investigated and in all the post-mortem or operative findings have corroborated the X-ray diagnosis. Four of these cases are described in the paper.

F. A. WILLIAMSON-NOBLE.

(2) **Junès, E. (Tunis).—Acute unilateral retrobulbar neuritis. (La névrite optique rétrobulbaire aigue et unilatérale.)** *Gaz. des Hôpitaux*, February 13 and 20, 1926.

(2) In view of the recent discussions in this country on the subject of retrobulbar neuritis and its relation to sinusitis, this long and full review of the subject by **Junès** is of much interest. After prefacing the whole with a reminder about the obscurity of the condition and its aetiology the author reviews in turn the onset, signs and symptoms, progress and prognosis of the condition, noting in particular the lack of signs in view of the severity of the symptoms, and stressing the frequency with which the condition ends in perfect recovery. The recognition of this is of considerable importance where credit for cure is given to some one particular line of treatment.

With regard to the pathological anatomy he discusses the presumed lesions from the aspects of meningitis, neuritis, or reflex vaso-dilatation in the nerve, the changes being first in function and later in structure, and attacking the macular fibres of the nerve, though centrally placed, because either of their delicacy or their distance from the main blood-vessels of the nerve at this point. Although searching for the aetiological factors "may be like a game of blindman's buff," he considers these at length under the headings: (1) Syphilis; (2) Disseminated Sclerosis; (3) Posterior Sinusitis; (4) Dental Lesions; (5) Miscellaneous Causes, *e.g.*, Rheumatism and Acute Specific Fevers.

The views on sinus and dental infections are the most interesting.

In each it is not the frank well-marked infection that is the type to account for an acute retrobulbar neuritis but certainly in the case of the sinuses it is an obvious but less striking infection of the congestive type. The evidence for such is not altogether convincing and the author stresses the fact that sinus or dental treatment, even if undertaken for a genuine lesion, may only synchronize with the typical rapid recovery which so frequently follows mere symptomatic treatment of the eye condition.

Although he considers the sinus infection a more potent factor in causation than oral sepsis he notes that it is generally held to account only for a very small proportion of cases. Undoubtedly many cases are due to early disseminated sclerosis though probably fewer than some observers hold. But probably the greatest number have to be relegated to the category of "idiopathic," in view of which it is fortunate that a quick recovery is so frequent a result. But in spite of this every effort should be made to locate a cause, and where this is beyond doubt it must be actively treated—such treatment to be in addition to the accepted local remedial measures to the eye.

R. C. DAVENPORT.

(3) **Zimmer (Avignon).—Reflections on certain cases of retrobulbar neuritis. (Réflexions sur certaines névrites rétrobulbaires.)** *La Clin. Ophtal.*, April, 1926.

(3) Under the above somewhat indeterminate title **Zimmer** is really bringing forward some interesting and possibly novel facts, namely, that for some time back he has been coming across cases of diminution of visual acuity in men, and especially in open-air workers, which would correspond in symptoms and appearances with tobacco amblyopia, but in which he has not been able to make out that tobacco was a probable cause. The author says that by "successive eliminations" he has come to the conclusion that these cases are due to the consumption of an inferior substitute for absinthe. Absinthe has been prohibited and has been replaced, it seems, by mixtures called *pastice* "which gave amateurs the illusion of their favourite liqueur." These mixtures which are contraband and are hawked round the country are composed of inferior alcohols and various drugs sufficient to account for the toxic effects on the eye. Unfortunately Zimmer does not state either the exact nature of the alcohols or of the drugs. While he sees no hope of prophylaxis he reports the cases in order to show his confrères the nature of the enemy to be fought. One must presume that *pastice* is a somewhat more insidious and less deadly concoction than the "liqueur" consumed by some people in this country—methylated spirit.

ERNEST THOMSON.

(4) **Abadie, Charles (Paris).—The treatment of tabetic optic nerve atrophy. (Traitement de l'atrophie tabétique des nerfs optiques.)** *La Clin. Ophtal.*, June, 1926.

(4) **Abadie,** after referring to the hopeless past of tabetics at a period when neither von Graefe nor Charcot had recognized the relation between tabes and syphilis, speaks of his theory of the cause of tabetic optic atrophy and its treatment. We no longer see the gross forms of locomotor ataxia, thanks to anti-syphilitic treatment, in the former numbers, but, unfortunately, we do see the accompanying optic atrophy with its usually hopeless prognosis. Abadie thinks, however, that there is no reason for absolute pessimism and that something can be done by treatment. His own theory is that the optic atrophy of tabes is due to permanent spasm of the central retinal arteries and consequent failure of nutrition of the nerve fibres. For some time he has submitted all his tabetic atrophies to the action of atropine. He began timidly with the internal administration of one milligramme per day, proceeded to subcutaneous injections and now employs intravenous injections of two milligrammes of atropine in two grammes of sterilized distilled water every day. This treatment is aimed at the spasm of the arteries, but the syphilis must also be treated. "Intravenous injections of cyanide of mercury, in the dose of one centigramme every second day, and practised *without interruption and so to speak indefinitely, constitute the best form of treatment.*" (Italics are the author's.) The treatment does not have an immediate effect: the good effects only commence at the end of one or two months; and, of course, the earlier the stage of the atrophy the better the results. No case histories or statistics accompany the article.

ERNEST THOMSON.

(5) **Abadie, Lacat, and Yoyotte (Paris).—Absolute blindness following serous meningitis. Complete restoration of vision after lumbar puncture. (Cécité absolue, suite de méningite séreuse. Rétablissement de la vision après ponction lombaire.)** *La Clin. Ophtal.*, February, 1926.

(5) **Abadie, Lacat,** and **Yoyotte** consider their case to be unique and wish to draw the attention of practitioners to it. The case is that of a married woman, aged 22 years, with no family or personal history of importance who, after an attack of influenza, became completely blind. In the first eye attacked the visual defect, which commenced as a round white spot in front of the eye and followed violent headache of frontal type, resulted in complete blindness in five days. The vision of the second eye began to be foggy a few days later and was completely abolished in 48 hours. The case seems of such importance as

coming from a man of Abadie's reputation that the symptoms and signs will be given almost textually. "The pupils are widely dilated and the pupil reflexes abolished; there is no perception of light. On ophthalmoscopic examination there was neither papilloedema nor papillitis. The arteries and veins had almost their normal calibre and the papillae their normal vascularity, but appear as if slightly veiled by a whitish mist (*buée*) which spreads out also along the vessels (uncoloured drawing given) recalling the appearance of opaque nerve fibres of congenital origin, but more delicate and as if veiled. The appearance gives the impression of a slight retinal oedema reminiscent of that seen a few hours after embolism of the central retinal artery. Nothing abnormal found in the urine. Probable diagnosis serous meningitis. Treatment by mercurial frictions and the artificial leech to the temples: then lumbar puncture which yielded 40 c.c. of cerebro-spinal fluid which escaped with force." The analysis of the fluid may be studied in the original. Recovery of vision commenced in four hours after the lumbar puncture and gradually improved up to L.E. 2/3, R.E. 1/3 in thirty-six days. The authors then say: "At the present day the patient may be considered cured," but as the date does not seem to be given the precise meaning of this is obscure. Commenting on the case the authors restate their opinion that the ophthalmoscopic appearances correspond neither to papillary stasis nor to inflammatory neuritis, but the exact interpretation of the mechanism which caused the retinal oedema is difficult to follow and the reviewer prefers not to attempt its translation.

ERNEST THOMSON.

(6) **Gérard, Georges, and Breton, André (Lille).—The late appearance of severe optic neuritis following treatment by rhodarsan. (Névrite optique très grave apparue tardivement après traitement au rhodarsan.)** *La Clin. Ophtal.*, April, 1926.

(6) The only hint as to the nature of rhodarsan given by **Gérard** and **Breton** appears to be that it is an arseno-benzol derivative. It is presumably a proprietary product which seems to be in use in France. At any rate the reviewer is unable to find it in the long chapter devoted to arsenical organic compounds in the latest edition of Martindale and Westcott. The authors commence by recalling the numerous accidents to vision which followed the original arsenical preparations such as 606 and atoxyl, accidents now much less common with our fuller knowledge. The actual case here recorded is that of a girl, aged 17 years, who was treated for a chancre by a total of 4.95 grammes

of rhodarsan spread over eight doses in 38 days. It is stated that this is a usual dose for the age. At the end of the treatment the Wassermann reaction was negative yet, in spite of the fact that the patient appeared to be normal in every other way she was attacked by "galloping" optic neuritis two and a half months after the last injection of rhodarsan. She became quite blind, no perception of light. Cyanide of mercury injections were given every day along with iodide. The authors have been very careless with their dates, but, so far as one can make out, about six weeks later the patient counted fingers at one metre. No further history is included.

ERNEST THOMSON.

(7) **McAlpine, Dr. D. (London).—Disseminated sclerosis: with special reference to its infective origin.** *Brit. Med. Jl.*, February 12, 1927.

(7) This paper by **McAlpine** gives a useful account of the modern views concerning disseminated sclerosis. Although the treatment of that complaint is outside the province of ophthalmology, it is frequently the ophthalmologist who makes the first diagnosis, since retrobulbar neuritis is one of the commonest early symptoms, and one which may long precede other obvious signs. The author makes out a good case for considering that the disease in question is the result of an active infective process in the central nervous system. In discussing Farquhar Buzzard's suggestion of a possible spirochaetal origin, he points out that three difficulties lie in the way of accepting this theory: (1) the fact that spirochaetes of various sorts are present in most animals used for experimental purposes; (2) it has not been found possible to obtain a growth of the spirochaetes so far found by various observers; (3) if the disease be spirochaetal in origin, then the difficulties are increased by the probability that we are dealing with a class of organism that has a life-cycle, and its other forms may be overlooked since we are unable to recognize them. Further, as regards the question as to whether the source of infection is endogenous or exogenous, he refers to Adams' observation of the relatively high proportion of agricultural labourers and woodworkers affected. Moreover, the geographical distribution of the disease as described by Steiner seems to suggest an exogenous source. Thus the disease is unknown in China and Japan, very rare in South America, and rare in Italy. It is most common in Switzerland, and also common in Germany, France, and Great Britain.

He discusses the peculiar liability to attack of the optic nerve and says that there are three possible explanations: (1) That the infective agent is present in the posterior ethmoidal or sphenoidal cells and gains access to the optic nerve by penetrating the very

thin barrier which separates these structures. (2) The subarachnoid space is continued out along the optic nerve to within a short distance of the eyeball. Certain other cranial nerves, the fifth, seventh, and eighth, also possess this prolongation of the subarachnoid space, but in the case of the optic nerve it is wider than in the others. If the virus of disseminated sclerosis be present in the cerebro-spinal fluid, then in view of these facts it is the optic nerve, bathed by the spinal fluid throughout its course, which would be most vulnerable. (3) Lastly, the possibility of a selective action of the virus on this particular nerve has to be considered.

The paper concludes with a useful summary of the methods of treatment and includes a brief bibliography.

E.E.H.

II.—DISEASE OF ORBIT

(1) **Nižetić, Zdravko (Nische, Serbia).—Cavernous lymphangioma of the orbit. (Le lymphangiome caverneux de l'orbite.)** *Arch. d'Ophtal.*, December, 1925.

(1) **Nižetić** publishes notes of a case of cavernous lymphangioma of the orbit, of which disease he has found only four recorded examples; the previous cases were reported by Foerster, Ayres, Wiener, and Wintersteiner.*

The author's patient was a female, aged 45 years, who came under observation complaining of prominence of the left eye and occasional diplopia, but no pain. There was a high degree of exophthalmos but no restriction of the movements of the eyeball. Vision was normal, the pupil active and the fundus healthy. At the temporal border a soft resistant mass could be felt, extending behind the eyeball. No pulsation could be detected.

An operation by Krönlein's method was performed. The tumour was found to be external to the cone of muscles, was removed without much difficulty, and the eyeball and bony segment replaced. The new growth was rounded, hard, "larger than a walnut," reddish-blue in colour. Macroscopically it appeared to be a vascular growth.

The microscopic examination was made by Professor Joannovitch of Belgrade who described its characters thus: The tumour consists of spaces filled with blood and lymph and lined by endothelium; some of these spaces have very delicate walls with scanty fibrous tissue; others are bounded by walls, in which are visible, besides the fibrous structures, smooth muscle fibres:

*Parsons (Pathology of the Eye, 1908) refers to five cases; those quoted by Nižetić and one recorded by Silcock.

there are also thicker septa containing lymphocytes in clusters. This histological structure is that of a cavernous tumour of lymph- and blood-vessels, a cavernous lymphangioma.

An illustration of the clinical appearances and one of the microscopic characters are given.

The report in most respects closely resembles that of Wiener's case. The retention of good visual acuity in both instances is explained by the position of the tumour external to the cone of muscles and exerting little or no pressure on the optic nerve.

J. B. LAWFORD.

(2) **Truc, H., and Dejean, Ch. (Montpellier).—Cavernous angioma of the orbit. (Angiome caverneux de l'orbite.)** *Arch. d'Ophtal.*, August, 1926.

(2) Cavernous angioma of the orbit is not common. At the date of this paper **Truc and Dejean** were cognizant of seventy published cases. At least one writer (Demarquay) has denied the occurrence of these tumours and thinks they should be included among the aneurysms and varices. However, their form, their angio-fibrous structure and encapsulation, their benign clinical characters, all well recognized, sufficiently attest their place in the nosological catalogue. In respect to their aetiology, however, our knowledge is more fragmentary. They develop after thirty years of age and progress slowly, inducing painless non-pulsatile irreducible exophthalmos. The possibility of a congenital origin cannot be wholly dismissed, even though their manifestation is long delayed.

The authors give a very full clinical and anatomical report of a case under their care. The patient was a male, aged 38 years, in whom proptosis had been noticeable for seven or eight years, and when seen by the writers had reached a high degree; it was accompanied by ptosis and limitation of ocular movements especially upwards and downwards. A rounded resistant mass could be felt above and behind the globe. It was painless on pressure and was not opaque to X-rays.

Actually the growth consisted of two unequal parts which were not continuous. They were removed through a large curvilinear incision just below the eyebrow, exposing freely all the orbital contents. The eyeball was retained and resumed its normal position immediately the tumour was extracted. Recovery was uninterrupted. Some months later the proptosis had almost entirely disappeared and the movements of the globe were again normal.

The histology of the tumours is described minutely and fully and three very good illustrations are given. The microscopic characters were typical of cavernous angioma.

J. B. LAWFORD.

(3) **Schlindwein, G. William, M.D. (Erie, Pa).—Orbital aneurysm.** *Amer. Jl. of Ophthal.*, September, 1926.

(3) **Schlindwein** reports an interesting case of orbito-facial aneurysm in a man, aged 54 years. The condition began at the age of 14 years, when he sustained a head injury followed by bleeding from the nose, mouth, and ears, and severe headaches. A year later there was swelling of the blood-vessels on his forehead and near his right eye for which he had ligature of a blood-vessel in the neck. Some relief followed this operation and the swelling diminished but there was still some pulsation and there were noises in the head and ears. When seen, the patient presented a massive swelling on the right side of the forehead, reaching over beyond the middle line, with an irregular corrugated surface, and displacing the right eye. He was suffering intense pain and demanded relief even when the risks of the operation were explained to him. The author, therefore, made an incision about an inch above the right eyebrow, found an eroded area of the frontal bone and then entered a large cystic cavity, filled with clotted blood, which was removed. Free venous bleeding occurred, but was controlled by packing with iodoform gauze, reinforced by two heavy sutures in the wound. Packing was carefully removed, beginning on the fifth day. A little post-operative infection occurred which cleared up, and since then there has been a gradual disappearance of the nodular masses, with complete relief of pain.

F. A. WILLIAMSON-NOBLE.

III.—DISEASE OF CORNEA

(1) **Barkan, Dr. H. (San Francisco).—Luetic interstitial keratitis of traumatic origin.** *Trans. Amer. Ophthal. Soc.*, Vol. XXIV, 1926.

(1) **Barkan** records four cases in which interstitial keratitis followed on injury. The nature of the injury was as follows: (1) blow from a nail causing large corneal abrasion; (2) blow with a heavy towel which left no apparent injury; (3) blow from a leather strap causing a subconjunctival haemorrhage; (4) lime in the eye. The first three cases were undoubtedly of specific origin with a strongly positive Wassermann reaction. The fourth was not seen till a week after the accident, and there is no note as to the Wassermann reaction. The author considers that the importance of his cases, with the exception of the last, lies in the fact that they were seen either on the same day or the day after the injury; that the injury consisted in a direct blow of some severity on the eye; and that interstitial keratitis developed under his personal observation

in so short a period as to leave no doubt as to the relation between the onset of the disease and the injury. After discussing the literature and pathological possibilities Barkan lays down certain rules as to the medico-legal aspect of these cases in industrial compensation questions. He considers that a case should be considered "industrial" under the following circumstances:

"(1) The effects of the trauma must be evident; (2) the trauma must have been of a sufficient character; (3) the case must be seen early enough after the injury to be certain of the sufficient character of the trauma and the absence of an interstitial keratitis antedating the trauma; (4) the development of the interstitial keratitis must commence within a reasonable period after the injury—from a few days to not later than two weeks; (5) the process must be typical enough so that no doubt of the diagnosis of interstitial keratitis can arise."

Our readers will remember that an interesting discussion of this subject took place at the Annual Meeting of the Ophthalmological Society of the United Kingdom in 1923.

Barkan has added to the value of his paper by a very comprehensive bibliography occupying nearly three pages of small print.

E.E.H.

(2) **Detroy, Leon (Lille).—Keratitis caused by mumps.** (**Kératite d'origine ourlienne.**) *La Clin. Ophtal.*, September, 1926.

(2) **Detroy** points out that while a number of eye conditions are said to have occurred with mumps, such manifestations as iritis, irido-cyclitis, and paralysis of accommodation must be accepted with some reserve. The case described seems to be quite proved as due to mumps. The condition of mumps was typical and occurred at a period of epidemic in a woman, aged 46 years. Failure of vision occurred simultaneously with the affection of the parotids and disappeared without leaving any trace along with the cure of the parotid swelling. The following is the author's description of the eye. Very marked pericorneal injection, pain accentuated by the slightest contact, opacity of the whole cornea, the grey infiltrated parenchyma of which exhibited, on a uniformly opaque ground, a series of still more opaque lines running criss-cross vertically and horizontally so as to mark out roughly square or lozenge-shaped spaces, thus giving the clear impression of a trellis. There was no involvement of the lacrymal gland and no hypertension. Vision was reduced to p.l. and no fundus reflex could be obtained. All this was on June 9. By June 28, the cornea was completely transparent and the visual acuity was 5/5. Treatment was by continuous atropinization.

ERNEST THOMSON.

(3) **Brusselmans, Paul (Antwerp).—A note on the employment of mydriatics and miotics in the treatment of peripheral perforating ulcers of the cornea. (Note sur l'emploi des mydriatiques et des myotiques dans le traitement des ulcères périphériques perforants de la cornée.)** *La Clin. Ophtal.*, October, 1926.

(3) **Brusselmans'** article seems thoroughly sound and is based on personal experience as well as on theory: nevertheless it traverses commonly held views. The title of the article might have been improved by the inclusion of words to express threatened perforation as well as actual perforation of the ulcer. He attacks the theory of the use of eserine with the intention of preventing peripheral adhesion of the iris to the cornea after perforation, or of reducing the risk of perforation. Eserine does not lower tension, or hardly lowers it, unless the tension is already raised. Eserine will not prevent the iris from being washed into the perforation: it is powerless to do so. Eserine improves the nutrition of the cornea by increasing vascularity of the ciliary region and iris. But this is an unwise procedure since there is already risk of iridocyclitis. Again, if the tension should be raised the proper procedure may be paracentesis. As a rule atropine is the drug to use in these cases, not eserine, perhaps assisted by dionine, the latter for the purpose of improving the nutrition of the cornea. The cases where eserine should be used are those sluggish ulcers with but little in the way of irritative symptoms, where there is never hypopyon and in which the iris does not participate. Here there is no risk of adhesions to the lens capsule and the corneal nutrition requires to be improved. In short, it is not the situation of the ulcer or the risk of perforation that should guide us in the employment of eserine or atropine but the clinical behaviour of the ulcer itself. Brusselmans' little argument on this subject is well worth perusal.

ERNEST THOMSON.

(4) **Garretson and Cosgrove (Detroit).—Ulceration of the cornea due to bacillus pyocyaneus.** *Jl. of Amer. Med. Assoc.*, March 5, 1927.

(4) **Garretson** and **Cosgrove** report six cases in which, in already injured eyes, severe ulceration occurred, due to the bacillus pyocyaneus, which was found in pure culture. The first case of this kind was reported by Sattler in 1891. A few other cases have been described, one by Angus McNab (erroneously called Agnes McNab by the author), in the *Ophthalmic Review*, 1904.

A. F. MACCALLAN.

BOOK NOTICES

The Study and Training of a Child who was Word-blind. By ELIZABETH E. LORD. **The Aetiology of Congenital Word Blindness.** By WALTER F. DEARBORN. Harvard Monographs in Education, Series 1, Vol. XI, No. 1, June, 1925. Pp. 76. Price 4s. 6d.

The first of these papers deals with a case of congenital word blindness, with a full report of its investigation and treatment, from the educational rather than the clinical aspect. It is hardly possible to abstract, but its conclusions from the point of view of the ophthalmic surgeon are perhaps best set out in words from its own summary

"Clinical and pathological evidence from cases of aphasia support a theory of brain localization in so far as the various acquired forms point to more or less isolated defects of vision, audition and motor response, which are involved in speech. As stated by Howell: 'Each part is a distinct centre, but their combined use in intellectual life would imply that they are connected by association fibres, so that a lesion may affect only one of these various centres . . . . although fundamentally distinct they are practically combined in activity.' In the psychological analysis of this case, all three centres concerned with speech (visual, auditory, and motor), present seeming abnormalities, and again we find that the question of defect is not confined to words and letters alone, but to sounds and numbers as well. In the pedagogical methods used we found that somewhat better results were obtained by appealing in the normal way to the visual memory than to either auditory or kinaesthetic memory. If our conclusions have been correctly drawn, so-called congenital word-blindness is not a pathological condition of a visual memory centre for words and letters, but is due to a defect in the association fibres; to insufficient associations between the sense areas and to lack of co-ordination in the motor response to visual and auditory stimuli."

The second paper deals more fully with the medical literature of the subject and arrives at the following conclusions:

"The upshot of our consideration of the literature of congenital word-blindness and of our experience with such cases is this: If there are specific defects in the centres or areas of the brain in which there is said normally to be deposited the visual memories of letters and words, these conditions will account for but a small proportion of the cases. Auditory difficulties, both central and peripheral must also be recognized, as well as muscular or kinaesthetic deficiencies and peculiarities. Secondly, there are cases which would appear to develop on a basis of pure habit,

especially with a supporting background of neurotic or psychopathic behaviour, but perhaps more commonly these factors merely complicate or are in part the result of the first-named deficiencies. Finally, some of the factors which are ultimately responsible for the condition of word-blindness, or for the inhibiting habits which result in this condition, would appear to be inheritable."

It is well that the attention of educationalists should be drawn to this by no means rare condition; and we should be glad if on this side of the Atlantic they were more fully cognisant of a pathological condition of varying severity, of which examples must not infrequently come under their observation and care.

Psychologische Optik. By Prof. Dr. AUGUST KIRSCHMANN, Leipzig. With 2 coloured plates and 60 figures in the text. Pp. 286. From Part VI of Abderhalden's Handbuch der biologischen Arbeitsmethoden. Berlin and Vienna: Urban und Schwarzenberg, 1927. Price 18.60 marks.

The keynote of this brochure is contained in the last sentence of the introduction: "Das Psychische ist das Primäre in der Welt." It betokens a rather dogmatic attitude, little amenable to impressions derived from alien, and perhaps at least equally valid, sources of knowledge. The title is somewhat misleading, for while the subject matter includes much that is generally called physiological optics, viewed from a psychological standpoint, it by no means covers the whole range of the psychology of vision. On the other hand, it includes a considerable section on the aesthetics of colour perception. It is not a work which can be recommended to the beginner: partly because he would have some difficulty in following the arguments; and partly because he would be unable to exercise the critical attitude to the statements which a somewhat unusual presentation of the subject demands. Yet for one who is familiar with physiological optics as taught in such textbooks as that of Helmholtz there could be no better exercise than the study of the subject from the psychologist's point of view. Unfortunately there are many psychological points of view, and it is not to be concluded that Professor Kirschmann's would commend itself even to all psychologists.

Commencing with an analysis of the complex visual presentation the book proceeds to deal with the classification of light "sensations," colour mixture, theories of colour vision, colour blindness, colour fields, after-images, contrast, etc. In this part the most fruitful original idea is that of the use of the reversed spectrum.

A second part deals rather inadequately with the "intensity of optical perception," including questions of photometry, adaptation, and Weber's Law.

The author is more at home with the subject of the third part—"the spatial features of visual presentations"—in which he devotes nearly twenty pages to a discussion on lustre. A chapter on pattern-construction (*Gestaltauffassung*) contains some interesting remarks on printing types, but merely touches the fringe of the now popular *Gestalt* theory. A short last chapter is devoted to optical illusions.

Die pathogenen Mikroorganismen des Auges. By Prof. Dr. F. v. HERRENSCHWAND, Innsbruck. With 12 coloured plates and 17 figures in the text. Pp. 310. Berlin and Vienna: Urban und Schwarzenberg, 1927. Price 24 marks.

In this book the bacteriology of the eye is treated from the standpoint of the bacteriologist rather than that of the clinician. Like the general pathologist, the general bacteriologist is liable to fall into error in dealing with eye diseases unless he has had special experience of them. We have found this work reliable, and it forms a welcome addition to the ophthalmological literature. With the exception of thirty pages the book treats seriatim each pathogenic organism which may affect the eye, and ophthalmic surgeons who peruse the list will probably be surprised at the number and variety of the organisms. In each case the morphological and cultural characteristics are exhaustively discussed, together with the results of experiments on animals. Perhaps the least satisfactory part of the descriptions is that dealing with the clinical manifestations in man; but these are already the most familiar to ophthalmologists and information upon them can usually be readily supplemented elsewhere. Specially interesting at the present time is the section on herpes febrilis, herpes zoster, and varicella; interesting, but less authoritative, is that on sympathetic ophthalmitis. The coloured plates are excellent.

Proceedings of the Optical Convention, 1926. In 2 vols. 4to, Part I, 512 pp.; Part II, 578 pp. Illustrated. Published by the Optical Convention, London, 1927. Price £3.

The two large volumes which contain the reports of the proceedings of the Optical Convention held in London in 1926 cover a surprisingly wide range of subjects. Several papers were read on each of the following subjects: optical theory, optical history and education, optical glass and the manufacture of optical instruments, astronomy, microscopy, spectroscopy, interferometry photography, ophthalmology and spectacle manufacture, cinematography and projection, colour, photometry and illumination, surveying including aerial surveying, and optical apparatus in the Services.

Several of these are of interest to ophthalmologists. A paper on "The influence of illumination on visual acuity" by Banister,

Hartridge, and Lythgoe brought out the fact that while an artificial illumination of 2 to 4 foot-candles is most probably adequate for a variety of purposes, only about one-half of the full acuity of the eye is achieved at these intensities; for the maximum acuity an intensity of 100 to 200 foot-candles is necessary. A "mechanical theory of heterophoric correction," suggested by J. B. Reiner, depended upon the postulate that the true anatomical position of rest for each eye is mid-way between the maximum rotation inwards and the maximum rotation outwards while the other eye is fixed upon an object in front. W. E. Barker dealt with some of the difficulties met with in prescribing glasses for the anisometrope, touching more especially upon the effect of decentration of the prescribed lenses and the use of bifocal lenses, while H. L. Taylor discussed the influence of facial asymmetry on the same problem. A comprehensive statistical report on the relative distribution of refractive defects was submitted by O. Aves, and a note on the transposition of obliquely crossed cylinders in irregular astigmatism into an equivalent sphero-cylindrical form was supplied by H. H. Emsley.

On the more theoretical side of the subject, Professor Elliott Smith delivered a lecture on the evolution of the eye and its relation to the development of its function. E. F. Fincham gave an illuminating account of his views on the mechanism of accommodation, described in this journal some time ago, presenting in detail the anatomical and physiological evidence he has accumulated during the last few years. Professor Peddie dealt with colour vision from the point of view of mathematical theory, and presented a new colour vision spectrometer for establishing colour matches and forming comparison spectra. One of the most interesting papers, which was followed by a suggestive discussion, was a discussion on the nature of light, introduced by Professor Lindemann, which dealt with the divergence between the electromagnetic and the quantum theories, the outcome of which was a general feeling that the essence of the two conflicting views would eventually be reconciled and combined.

Many papers are devoted to the description of complex optical instruments, and these provide ample justification for the claim made by Sir Frank Dyson, the Astronomer Royal, in his Presidential Address, that this country holds a very high position in the world of optical science, and that the optical industry has every reason to congratulate itself on its achievements, both in the theoretical and practical side of its activities. For this satisfactory state of affairs the war may be largely responsible by making a virtue of necessity, and it will be recalled that the assertion has been publicly made on several occasions by prominent representatives of the Services, and the large users of optical

instruments, that during and since the war Great Britain has regained her position of leadership in optical manufacture. The prestige of Jena provides no mean standard for competition; but a perusal of these pages makes it abundantly clear that in the elaboration of new instruments and in the continued refinement of the old ones, and in the variety and quantity of its output, the British optical industry has every reason to congratulate itself on a record of continued progress based on the essential scientific foundation which should underlie every advance in manufacture.

Guide to Ghent. By Mrs. SYDNEY STEPHENSON. Pp. 78, with map and 6 illustrations. London: George Pulman and Sons, Ltd. Price 1s. 6d. net.

We extend a cordial welcome to this excellent tourist's handbook to one of the most renowned of foreign towns, which Mrs. Sydney Stephenson has dedicated to the memory of her husband. It is the best thing of its kind that we remember to have seen; well printed on good paper and packed with detail, historical, topographical, and commercial; it should be a boon to any English visitors to Ghent. The illustrations are reproduced from photographs and are wonderfully good.

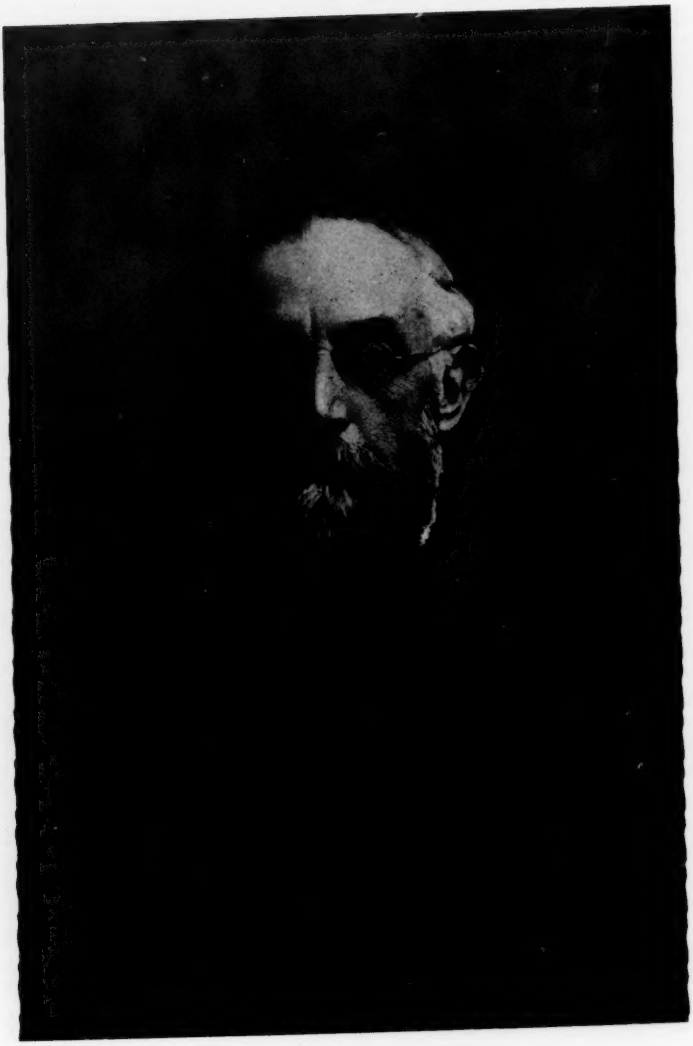
Saving Eyesight after Mid-life (Harvard Health Talks). By J. H. WAITE, M.D. Pp. 48, with 6 diagrams. Harvard University Press: Humphrey Milford. London: Oxford University Press. 1927. Price 4s. 6d. net.

This useful little book is written rather for the educated laity than for the profession; it contains in small compass a great deal of valuable information and can be safely recommended to the public. The main thesis of the booklet is insidious chronic glaucoma, but attention is called also to other causes of blindness occurring after middle life, such as vascular disease, cataract and intraocular neoplasms. The facts are stated simply, so as to be intelligible to the non-medical mind. The old dictum that a little knowledge is a dangerous thing will lose much of its force in this instance, if this book is read by those to whom it is addressed, and if the advice here contained is followed.

An Illustrated Guide to the Slit-Lamp. By T. HARRISON BUTLER, M.A., D.M. (Oxon). Pp. 144, 158 illustrations, 5 coloured plates. Humphrey Milford. London: Oxford University Press. Price 30s. net.

Considering what we owe to Mr. Harrison Butler for his advocacy of the slit-lamp, and the pioneer work he has done in introducing it to the notice of ophthalmic surgeons in this country, it is right that the first original book on the subject, in English, should be from his pen.

OF MICH



WAREN TAY.

The book is a handsome one, very well illustrated by drawings by the author himself, and its printing and general production up to the standard we expect from the Oxford University Press.

The general arrangement is original in many details, both in the sequence of chapters and their subject matter. After describing the Zeiss apparatus there follows a description of the various methods of examination open to the user. Then follow chapters on the cornea, localization and measurement, succeeded by a consideration of abnormalities of the cornea. The anterior chamber is next briefly surveyed, and then follows a long chapter on inflammation in general. After this the iris and lens with their abnormalities are treated in detail. A chapter is devoted to the retro-lental space and vitreous and after this four chapters are set aside for a somewhat discursive treatment of the effect of operations and injuries, the value of the slit-lamp in medico-legal cases, the retina, and finally a description of slit-lamp methods with simple apparatus.

All users of the slit-lamp will not agree with some of the terms used in translating from the French and German, but it is to be remembered that the language of the slit-lamp is not as yet stereotyped. We hope that when standard terms come to be adopted some improvement may be found for such words as "collarette," "retro-illumination," etc. We might also point out that the term "optically inactive" has a special meaning with regard to polarized light, and should not have been used as a translation of Koby when he states that, "derrière la capsule s'étend un espace peu profonde, optiquement vide." These, however, are minor criticisms of a book which is more of an atlas than a textbook, and which should prove of great value to all users of the slit-lamp.

OBITUARY

WAREN TAY

IT is hardly possible to think or write of Mr. WAREN TAY, who died on May 15 in his eighty-fourth year, without comparing him with the master of whom he was such a devout disciple, Sir Jonathan Hutchinson. Both were born and bred in Yorkshire, both came to London for their medical education and settled down there in private practice.

Hutchinson was often spoken of as "a universal specialist" on account of the number of different subjects upon which he could speak authoritatively, and Tay in like manner became skilled in the practice of several different branches of his profession.

To the writer, who for some years had been working with Tay

before he knew Sir Jonathan, it was a matter of surprise to find how many of the habits and mannerisms he had learnt to associate with the younger man must have been acquired unconsciously from his teacher.

Tay was a student at the London Hospital, obtained the qualification of M.R.C.S. in 1866, and that of F.R.C.S. three years later. At the London Hospital he soon came under the influence of Hutchinson, who was the lecturer on surgery; the acquaintance thus started between the solemn and impressive lecturer and the conscientious and earnest student, rapidly ripened into friendship. After having held the usual residential appointments Tay became Hutchinson's clinical assistant at the various Institutions with which he was connected, much, as it turned out, to their mutual advantage, Hutchinson obtaining the aid of an acute clinical observer with literary abilities, and Tay receiving support and assistance in obtaining the hospital appointments which gave him an assured position in his profession in London.

In 1868 he was appointed Assistant Surgeon to the Hospital for Diseases of the Skin at Blackfriars and full Surgeon in 1875, which post he continued to hold until 1907. In 1869, at the early age of 25, he became Assistant Surgeon and Ophthalmologist to the London Hospital, and full Surgeon with charge of beds in both the general surgical and ophthalmic wards seven years later. He retired from the London Hospital in 1902.

He was appointed Surgeon to the North-Eastern Hospital for Children (now the Queen's Hospital for Children) in 1869, being closely associated with the founders of the Hospital, Mary and Ellen Phillips, and the earnest Quaker group that supported them in their good work, amongst whom were John Phillips (their father); Edmund Pace; William Beck, the architect, who for a time shared a house with Hutchinson in Finsbury Circus; John D. Fry and Dr. Alexander Fox. Tay continued to work at this hospital for twenty years doing the ophthalmic work which was required there together with that of general surgery.

Tay's first connection with Moorfields Eye Hospital was as clinical assistant, together with Edward Nettleship, to Jonathan Hutchinson. It was whilst so engaged in the years 1874-5 that he discovered in the fundus of the eye ophthalmoscopically, an appearance which had not previously been described, consisting of minute yellowish white dots in the choroid around the macula, the condition which is now so widely known as "Tay's Choroiditis." It was characteristic of Tay's modesty and lack of self assertiveness that he did not hasten to publish a description of this discovery himself. He showed it to Hutchinson who wrote an article on the subject in the *Royal London Ophthalmic Hospital Reports* (Vol. VIII, 1875, page 231) entitled "Symmetrical Central

Choroido-Retinal Disease Occurring in Senile Persons." At the conclusion of the article Hutchinson makes his acknowledgment to Tay in the following terms: "It is only right that I should state, in concluding my report, that I was indebted to my friend and colleague, Mr. Waren Tay, for much more than the mere notes of the first cases. The patients were under my care, but it was he who made the ophthalmoscopic examination, and drew my attention to the peculiarities presented. I have failed to find in our standard works and atlases any description of similar cases." It is noteworthy that Hutchinson did not speak of the condition as "choroiditis," but in discussing the nature of the dots said: "it may be suggested as not improbable, that the small round white spots are allied in seat and structure to the so-called 'colloid' excrescences from the lamina elastica," a surmise which, whether Hutchinson's or Tay's in the first instance, has subsequently been found to be correct.

In 1877, on the retirement of Bowman and Critchett from the staff at Moorfields, Tay, and his colleague at the London Hospital, James Adams, were appointed to take their places. Tay's surgical interest was more in the study of the natural history of disease than in the practice and display of manual dexterity. A steady and reliable operator himself he delighted in providing opportunities for younger men to gain experience, and there are many who look back gratefully to the assistance he thus afforded them in their early career. So sympathetic and kindly-disposed a man as Tay, who would give away operations, and allow records of his cases to be made use of for purposes of publications, naturally attracted around him a good type of assistant. Amongst those who worked under him at Moorfields were many who attained conspicuous positions in ophthalmology, *e.g.*, Stanford Morton. Adams Frost, Ernest Clarke, Percy Dunn, Roxburgh, Arthur Thompson, Hallidie of St. Leonards, and Cooke of Cambridge.

Tay was one of the small group of men who in the late seventies used to congregate together in the evenings in the House Surgeon's room at Moorfields to discuss cases, meetings out of which the Ophthalmological Society ultimately developed. He was an original member of that society and one of its first members of Council. In Vol. I of its Transactions is recorded, with an ophthalmoscopical drawing which has since become classical, a case shown by Tay which he entitled "Symmetrical changes in the region of the yellow spot in each eye of an infant." This was the first described case of what we now know as "Amaurotic Family Idiocy." Tay gave a complete and accurate description of the clinical symptoms of the disease, and in 1884, in Vol. IV of the Transactions recorded a second case from the same family, thus showing its family tendency which has since been found to be such

a characteristic feature. Though Tay's first case died, the parents would not permit an autopsy so he was unable to investigate the pathological condition. This was first done by Dr. B. Sachs in a case of Knapp's in New York, hence the description of the affection sometimes known as "Tay-Sachs' Disease."

In the seventies the surgeons at Moorfields commenced to publish in connection with the *Ophthalmic Hospital Reports* a *Periscope* of contemporary ophthalmic literature, the translations of the foreign articles in it being mostly Tay's work. This *Periscope* was continued until the appearance of the *Ophthalmic Review* as a separate journal rendered it no longer necessary. Tay also translated one of the volumes of Hebra's "Diseases of the Skin" for the New Sydenham Society of which Jonathan Hutchinson was the secretary.

Tay continued his work at Moorfields until the retiring age; in the latter part of his hospital career, his strong conscientious rectitude and growing dread of not being quite up to date made him lose a certain amount of self-reliance; so that instead of becoming dogmatic and self assertive with age, he tended to be unduly deferent to the opinion of younger and far less experienced men.

He resided during his professional life at No. 4 Finsbury Square, a house which though it faced on the busiest side of the square had the advantage of backing on to the large open space of the Honourable Artillery Company's grounds. Finsbury Square and Circus, when Tay first went to live in the neighbourhood, were quiet residential oases abutting on the City of London, they have now become noisy and commercial. Many of the houses were at that time occupied by members of the staff of Guy's and the London Hospitals upon whom it was obligatory to reside in the vicinity of those institutions. Tay had, therefore, living around him friends and colleagues with whom at week-ends his love of nature made him delight in making long pedestrian expeditions into the country.

He was an enthusiastic cyclist, riding a tricycle long before the safety bicycle was invented, and with his customary thoroughness visiting regularly the cycle shows and making himself familiar with every new invention and improvement.

Tay never married and led, especially in his latter years, a somewhat lonely life. He found, however, a great solace in literature and like his colleague Dr. Hughlings Jackson was a voracious reader of fiction. After he retired from practice he resided at Croydon. His latter days were clouded with the dread that he might become cut off from the solace of his books by the loss of sight, for he suffered, as Jonathan Hutchinson had done, from chronic glaucoma. Fortunately, in both cases it was only one eye

that became seriously involved, the disease in the better eye being kept in check by the use of miotics.

Tay possessed an exceeding gentle and self-denying nature, he abhorred anything cruel or rude. Though he thoroughly enjoyed a joke he did not like being made fun of himself, being particularly sensitive to ridicule. On the other hand he never seemed to forget any little service which had been rendered him and was unfailingly loyal to his friends and assistants. Had he chosen to be more pushful, there can be little doubt that with his abilities and vast experience he might have attained to the highest rank in his profession. As it is his name will live in ophthalmology in connection with the two affections of the fundus of the eye which he discovered, and his memory will be held in high esteem by all those who were fortunate enough to work with him as assistants.

E.T.C.

NOTES

Mayor of Exeter

COLONEL RANSOM PICKARD, C.B., C.M.G., M.S., F.R.C.S., who is this year Mayor of Exeter, was entertained at dinner on April 26 by members of the medical profession in Exeter and the neighbouring parts of Devon. Colonel Pickard is not the first ophthalmologist to hold this important civic post in Exeter, since he was preceded by the late Mr. A. C. Roper. We are sure that all readers of the BRITISH JOURNAL OF OPHTHALMOLOGY will wish to join with us in congratulating him on this high honour shown him by his fellow citizens.

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Hon. LL.D., Edin.

AMONG those upon whom the Honorary Degree of Doctor of Laws will be conferred by the University of Edinburgh on the occasion of the meeting of the British Medical Association in that city in July we are pleased to note the names of Sir John Parsons and Professor van der Hoeve.

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Trachoma organism

IT is reported that Professor Noguchi has succeeded in isolating a minute Gram-negative, pleomorphic, aerobic, motile, flagellated bacillus from cases of trachoma amongst American Indians. Monkeys inoculated with a pure culture showed all the signs of trachoma and the same organism was recovered from the inoculated monkeys. In none of these cases were any "inclusion-bodies" found. We look forward with interest to the publication of the full report of a discovery, the importance of which, if confirmed, can hardly be overestimated.

Appointment

Major J. N. DUGGAN, D.O.(Oxon.), I.M.S., has been appointed ophthalmic surgeon-in-charge of the Sir C. J. Ophthalmic Hospital Bombay, as from January 1, 1925; *vice* Lieut. Col. G. McPherson, C.I.E., I.M.S.

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Egyptian Ophthalmological Society

THE Egyptian Ophthalmological Society held its annual meeting on April 15, 1927, and celebrated its 25th anniversary by giving a dinner at the Continental-Savoy Hotel of Cairo.

The election of the following officers took place:—President: Dr. Mahmoud Riad, Surgeon to Ophthalmic Section, Kasr-el-Aini; Vice-President: Dr. A. A. Aguizi Bey, M.P., Egypt; Hon. Secretary: Dr. M. Sobhy Bey, Ophthalmic Hospital, Giza; Assistant Secretary: Dr. M. Khalil, Kalaoun Ophthalmic Hospital; Treasurer: Dr. E. H. El Maziny Bey, Director, Ophthalmic Hospitals, Cairo.

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St. Margaret's Hospital for Ophthalmia Neonatorum

THE annual returns for St. Margaret's Hospital for ophthalmia neonatorum for the year 1926 are as follows:—

No. of Children Admitted.		No. of Mothers admitted.		No. of Children discharged with both eyes blind.		No. of Children discharged with single eye blind.		No. of Children discharged with single eye impaired.		No. of Children discharged with both eyes impaired.	
1925	1926	1925	1926	1925	1926	1925	1926	1925	1926	1925	1926
186	184	116	107	—	—	—	—	10	18	7	7

Year.	No. of Cases Notified.	No. in St. Margaret's Hospital.
1925	700	186
1926	709	198

FUTURE ARRANGEMENTS

1927

July 7-9.—Annual Meeting of the Oxford Ophthalmological Congress at Oxford.

July 20-22.—The British Medical Association, Section of Ophthalmology, at Edinburgh.